



# Height variability of solar effects on dynamical processes of middle atmosphere

A. Fahrutdinova, A. Elkin \*, V. Guryanov

*Physical Department, Kazan State University, 18, Kremlyovskaja Street, Kazan 420008, Russia*

Received 5 November 2004; received in revised form 24 June 2005; accepted 27 June 2005

## Abstract

Large-scale changes observed in the atmosphere can be explained by the connection with solar processes. For region of Kazan the within-year variability is mainly determined by annual and semi-annual oscillations, which are investigated in the present work. The analysis of height profiles of coefficients of dependence of these processes on solar activity demonstrates the expressed height variability of their values, even change of their sign. The most expressed 11-year oscillation of the solar activity is in antiphase with 11-year periodicities of variations of annual average values of zonal wind. For the series of amplitudes of annual oscillations it is in phase with solar activity variations. In all probability, the most expressed solar effects on large-scale dynamic processes of atmosphere are mainly caused by 11-year periodicity of variations of solar activity.

© 2006 Published by Elsevier Ltd on behalf of COSPAR.

**Keywords:** Solar effects; Height variability; Dynamical processes

## 1. Introduction

The investigation of influence of solar activity on dynamical processes of atmosphere is an ongoing theme, which arouses interest of geophysicists, climatologists and meteorologists at the present. Large-scale changes observed in the atmosphere can be explained by the connection with solar processes.

The height dependence of solar activity influence on annual average values as well as on annual and semi-annual oscillations of zonal and meridional wind velocities and of atmospheric planetary wave intensity variations of lower and middle mid-latitude atmosphere on heights of 0–55 km and 80–110 km for the region of Kazan (56N,49E) is investigated in this paper.

For investigation of solar effects on dynamical processes of the atmosphere the data of zonal and meridional wind velocities BADC UKMO for heights 0–55 km

for the period 1992–2003 and the data of radiometeoric sounding of upper mesosphere–lower thermosphere obtained on radar of Kazan State University for heights 80–110 km for the period 1986–2002 have been used.

Long-time series (commensurate with 11-year cycle of solar activity) are used in the analysis which gives the significant results and allows us to detect the essential height changes of coefficients of dependence of the investigated dynamical parameters on solar activity. Besides that, the data of zonal wind velocity averaged in the height interval 80–110 km for the periods 1980–1986 and 2002–2003 has been used, which is also obtained by the radiometeoric method on the Kazan State University's radar.

Attempts to determine the solar effects on time variations of zonal and meridional mid-latitude circulation for upper mesosphere–lower thermosphere were made earlier (Sprenger and Schminder, 1969; D'Yachenko et al., 1986; Greisiger et al., 1987; Namboothiri et al., 1993; Jacobi et al., 1997; Bremer et al., 1997). The authors used 10–30 km averaged wind velocity data

\* Corresponding author. Tel.: +7 8432 315176.

E-mail address: [aelkin@ksu.ru](mailto:aelkin@ksu.ru) (A. Elkin).